Abstract.—The impact of oil and gas development on fish populations off Louisiana is presumed significant but poorly understood. This study was undertaken to determine the applicability of a logbook program in developing a long-term database of species composition and relative abundance of fish associated with oil and gas structures. A pilot logbook program involving 120 private vessel owners and 25 charterboat operators was conducted between March 1987 and December 1988. Participants recorded date, fishing time, fishing method, number of anglers, and catch composition at each structure fished. Logbooks from a total of 55 private vessel owners and 10 charterboat operators were used in the analysis. Data collected included 15780 angler hours of fishing effort and 61227 fish caught over the study period. A total of 1719 trips were made to 589 different oil and gas structures with at least 46 different species of fish caught. Red snapper and spotted seatrout were the most commonly caught species and had the highest catch rates. Results differed from past logbook programs and creel surveys, possibly indicating a change in the community of fish associated with oil and gas structures.

A Fishery-dependent Based Study of Fish Species Composition and Associated Catch Rates Around Oil and Gas Structures Off Louisiana*

David R. Stanley
Charles A. Wilson
Coastal Fisheries Institute, Center for Wetland Resources
Louisiana State University, Baton Rouge, Louisiana 70803-7503

Louisiana has long been revered as a "Sportsman's Paradise" and justifiably so, as evidenced by the abundant recreational fishing opportunities. A contributing factor to this "paradise" is the large number of oil and gas platforms acting as defacto artificial reefs. There are approximately 3700 oil and gas structures that constitute 28% of the known hard substrate off Louisiana and Texas (Gallaway 1984). Since the nearest natural hardbottom habitat is approximately 92 km off the Louisiana coast (Sonnier et al. 1976), oil and gas platforms provide the only source of hardbottom habitat (i.e., artificial reefs) close to shore.

Oil and gas platforms are unique as artificial reefs because they extend throughout the entire water column. Due to the size and shape of the structures they are thought to affect benthic, demersal, and pelagic fishes (Gallaway et al. 1981, Continental Shelf Associates 1982). Pelagic baitfish (i.e., round scad *Decaptarus punctatus*, Spanish sardine *Sardinella anchovia*, and scaled sardine *Harengula pensacolae*) often maintain a position from near the surface to mid-depth within or upcurrent from oil and gas structures, while large predatory pelagic fishes (i.e., king mackerel *Scombermorous cavalla*, and blue runner *Caranx crysos*) were reported to swim from the surface to mid-depth around structures (Hastings et al. 1976, Gallaway et al. 1981).

Evidence for the success of platforms as artificial reefs comes from sportfishing which is concentrated around these structures off the coast of Louisiana. An estimated 37% of the total saltwater angling effort and over 70% of all recreational angling trips that venture into the Exclusive Economic Zone (more the 3 miles from shore) off Louisiana occur around platforms (Witzig 1986, Reggio 1987).

In general there is little known about the species associated with oil and gas structures. Reported catch composition of charter boat operators fishing oil and gas platforms included (unranked): snapper (Family Lutjanidae), seatrout *Cynoscion* sp., Atlantic croaker *Micropogonias undulatus*, red drum *Sciaenops ocellatus*, king mackerel, cobia *Rachycentron canadum*, bluefish *Pomatomus saltatrix*, and sharks (Order: Selachii) based on studies by Dugas et al. (1979) and Ditton and Auyong (1984). Similar catch compositions were reported for private vessel anglers (Ditton and Auyong 1984, Stanley and Wilson 1989). In general, bottom fishing was reported to be the predominant fish-

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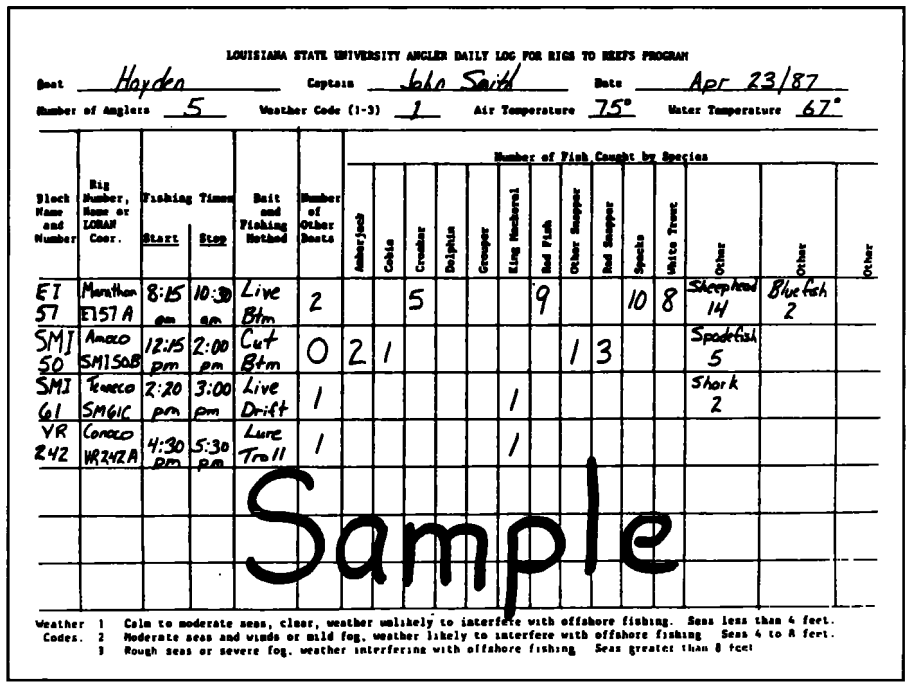

LOUISIANA STATE UNIVERSITY ANGLER DAILY LOG FOR RIGS TO REEFS PROGRAM

Boat Hayden Captain John Smith Date Apr 23/87

Number of Anglers 5 Weather Code (1-3) 1 Air Temperature 75° Water Temperature 67°

Block Name and Number	Rig Number, Name or LORAN Coor.	Fishing Time Start	Fishing Time Stop	Bait and Fishing Method	Number of Other Boats	Number of Fish Caught by Species: Amberjack	Cobia	Croaker	Dolphin	Grouper	King Mackerel	Red Fish	Other Snapper	Red Snapper	Spanish	White Trout	Other	Other	Other
EI 57	Marathon EI57A	8:15 am	10:30 am	Live Btm	2			5				9			10	8	Sheepshead 14	Bluefish 2	
SMI 50	Amoco SMI50B	12:15 pm	2:00 pm	Cut Btm	0	2	1						1	3			Spadefish 5		
SMI 61	Tenneco SMI61C	2:20 pm	3:00 pm	Live Drift	1						1						Shark 2		
VR 242	Conoco VR242A	4:30 pm	5:30 pm	Lure Troll	1						1								

Sample

Weather Codes. 1 Calm to moderate seas, clear, weather unlikely to interfere with offshore fishing. Seas less than 4 feet.
2 Moderate seas and winds or mild fog, weather likely to interfere with offshore fishing Seas 4 to 8 feet.
3 Rough seas or severe fog, weather interfering with offshore fishing Seas greater than 8 feet

Figure 1
Sample page from offshore logbook program.

ing method used by charterboat operators and private vessel anglers. However, Dugas et al. (1979) reported that trolling was the dominant fishing method used by private vessel anglers in Louisiana, with bottom fishing second.

Highest catch rates while trolling off the Louisiana coast by charterboat operators from 1982 to 1985, calculated as number of fish caught/boat hour (CPH), were 9.19 for dolphin in 1982 and 9.04 for Spanish mackerel in 1985 (Brusher et al. 1984, Brusher and Palko 1985, 1987). Bottom-fishing catches off the Louisiana coast by charterboat operators consisted chiefly of Atlantic croaker, red snapper, sand seatrout *C. arenarius*, unidentified seatrout, grey triggerfish *Balistes capricus*, bluefish, and king mackerel, with highest CPH's of 23.45 for sand seatrout and 12.38 for Atlantic croaker in 1984 (Brusher et al. 1984; Brusher and Palko 1985, 1987).

A method by which to test the success or value of an artificial reef and develop a data base on species composition is by tracking the number of fish caught over time, under the assumption that catch per unit effort (CPUE) of the target species is proportional to the abundance of fish. The resultant CPUE can then be used as a measure of relative abundance of fish, and the effects of an artificial reef such as an oil or gas platform can be assessed. For the target species of both the avid recreational angler and researcher, CPUE is a good index of relative abundance (Peterman and Steer 1981, Casselman et al. 1985, Richards and Schnute 1986). Users of such data, however, should be aware that the variability of CPUE estimates can be a problem with any sampling program and can change with different sampling gears. However, Casselman et al. (1985) found that the coefficient of variation of angling catches by experienced, avid, or professional fishermen such as charterboat operators was significantly lower than for other sampling techniques such as trawling, electrofishing, gillnetting, and trapnetting.

The goals of this study were to (1) record and quantify the catch rates and species composition for fish caught by recreational anglers and charterboat operators at or near oil and gas platforms off the Louisiana coast; (2) compare our results with past studies from the northern Gulf of Mexico; and (3) determine the utility of using CPUE estimates of the target species caught near the platforms as an index of their relative abundance.

Materials and methods

Volunteers (120) were solicited to maintain log books from fishing clubs across Louisiana. In addition, 23 charterboat operators listed in National Marine Fisheries Service records, and Coleman (1984) volunteered to maintain logbooks. Study participants were provided with logbooks and program information. Monthly contact was made with study participants to ensure their assistance.

Logbook design was based on the Lake Erie Angler Diary Program (Sztramko 1986) and logbook criteria

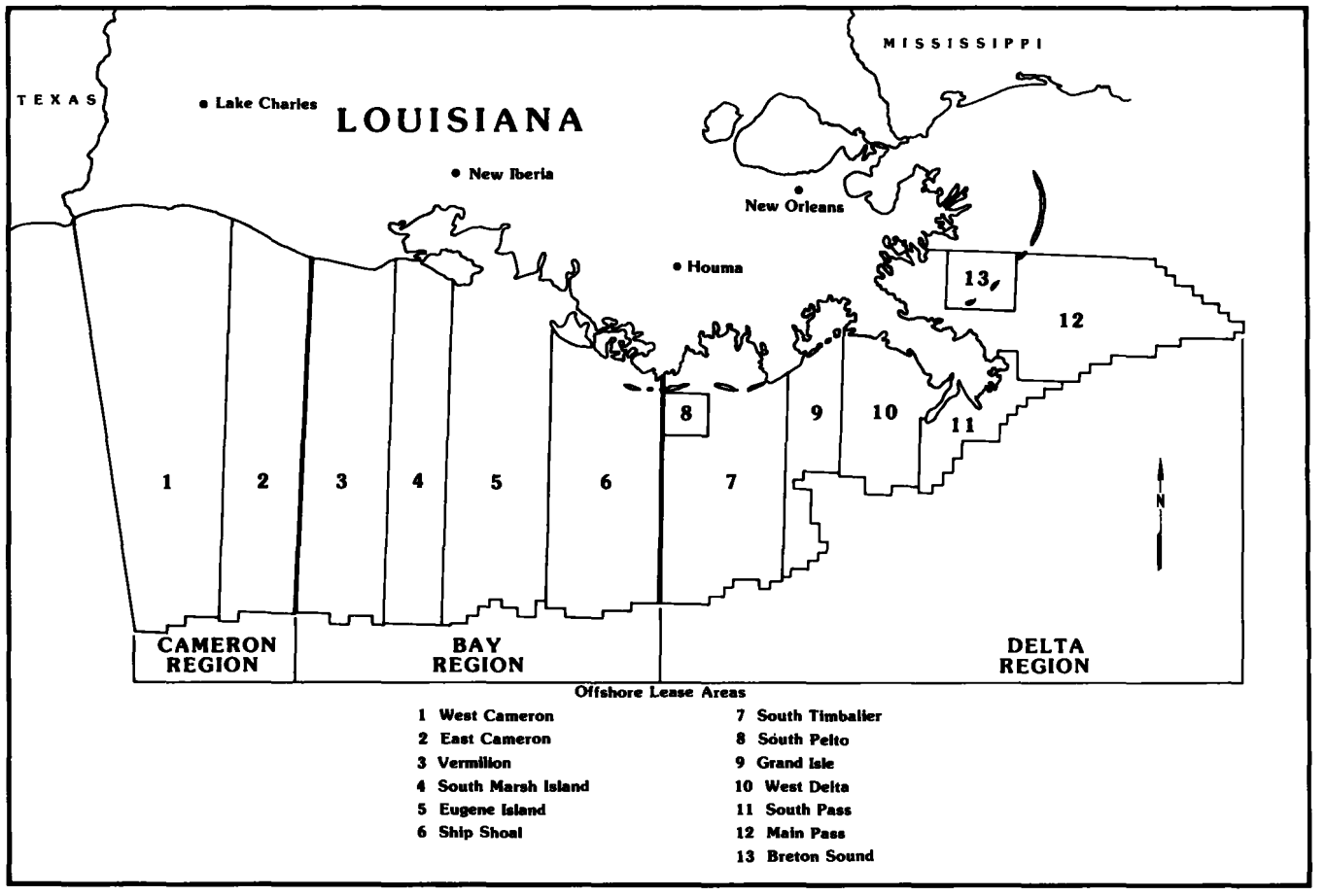

Figure 2
Three regions of the Louisiana offshore study area.

outlined by Demory and Golden (1983). Information entered into the logbooks included date, number of anglers, identity of the oil and gas platform fished, fishing time (not including travel time), fishing method, bait used, and the number of fish caught by species. Participants were asked to complete at least one page of the logbook for each fishing day (Fig. 1). Logbook data were collected from March 1987 to December 1988. Due to the difficulty of identifying certain species of fish such as snapper other than red snapper, groupers, sharks, and silver and sand seatrout, these species were classified as other snapper, groupers, sharks, and silver/sand seatrout, respectively. Other data acquired from study participants included boat length (m), total engine horsepower, and the presence of electronic gear (i.e., LORAN, graph recorders, and echosounders) which aided in the capture of fish. Submerged surface area (m^2) and volume of water enclosed (m^3) by each structure utilized by the participants in 1987 were calculated from schematic diagrams provided by the platform operators.

Fishing effort and CPUE (number of fish caught/angler hour) estimates were separated into two categories: nearshore and offshore fishing. Nearshore fishing around oil and gas platforms was defined as any time at which spotted seatrout were caught, and offshore fishing was defined as trips during which spotted seatrout were not caught. Offshore fishing was further subdivided into bottom fishing (during which time the boat is moored to an oil and gas platform) and trolling. The rationale for the separation of the effort into two categories was due to the segregation of the fish species, as spotted seatrout and red snapper were caught together only 0.7% of the time. Nearshore fishing generally took place in less than 10 m of water where target species were nearshore species such as spotted seatrout, red drum, Spanish mackerel, etc. In contrast, offshore fishing occurred in much deeper water and the target species was usually red snapper; however, a wide range of species were caught with the exception of spotted seatrout. The bait and gear used during the two types of fishing were very different.

Table 1

Descriptive statistics on the number of anglers, man hours, and time spent fishing per oil and gas platform off Louisiana by charterboat operators (CBO) and anglers for inshore fishing and offshore bottom fishing and trolling from logbook records, March 1987–March 1988.

	Time/platform (hrs)				Number of anglers			
	1987		1988		1987		1988	
	Anglers	CBO	Anglers	CBO	Anglers	CBO	Anglers	CBO
Inshore								
N	174	109	62	4	174	109	62	4
Mean	2.8	2.4	2.5	3.6	3.2	3.9	2.8	4.8
SD	2.3	2.3	1.6	2.1	0.8	0.9	0.7	1.0
Offshore bottom								
N	362	578	228	211	362	578	228	211
Mean	2.4	1.3	2.3	1.1	3.7	8.7	3.5	9.6
SD	2.1	1.1	2.1	1.0	2.0	4.6	1.7	3.4
Trolling								
N	130	33	76	14	130	33	76	14
Mean	1.7	2.5	1.4	2.6	3.9	3.5	2.9	4.5
SD	1.8	2.3	1.1	2.3	2.1	1.1	0.9	0.8

While nearshore fishing, light spinning, and bait cast tackle were utilized with natural or artificial baits, offshore fishing tackle generally consisted of heavy boat rods with level wind reels using at least 30-lb test line.

Catch data from various capture methods are usually not distributed normally due to the large number of zero values. Therefore, CPUE was transformed by ln(CPUE + 1) to approximate the normal distribution of the catch data (Pennington 1983, 1985; Shaw et al. 1985). To compare catch rates of red snapper and spotted seatrout between user groups and years, an ANOVA (SAS 1985) was utilized. A Duncan's multiple range test (SAS 1985) was performed to determine differences in red snapper catches between the three regions of coastal Louisiana (Fig. 2). Based on Univariate Analysis (SAS 1985) of the residuals from ANOVA tests and Duncan's multiple range tests, statistical comparisons could only be made between user groups and years for spotted seatrout and red snapper and among areas and years for red snapper to comply with the assumptions of the statistical tests utilized.

Results

A total of 55 private boat operators and 10 charterboat operators returned usable logbooks in 1987, and 30 private boat operators and 5 charterboat operators in 1988, representing return rates of 45.8% and 43.5% in 1987, and 25.0% and 20.8% in 1988, respectively. Participants fished at 589 different oil and gas platforms 1787 separate times over the study period. Anglers fished at oil and gas platforms on 666 occasions in 1987 and 362 times in 1988. Charterboat operators fished at platforms 530 times in 1987 and 229 times in 1988. In 1987, private vessel and charter operator logbook participants spent a total of 2482 hours fishing, representing 11014 angler hours. During 1988, 1057 vessel hours were spent fishing which accounted for 4780 angler hours of fishing. Charterboat operators carried more fishermen than did the private vessels for all three fishing methods (Table 1).

The most prevalent fishing method for both private boat and charterboat anglers during 1987 and 1988 was offshore bottom fishing. Offshore bottom fishing accounted for 54.5% (1987) and 63.2% (1988) of private vessel fishing trips, and 73.2% (1987) and 92.1% (1988) of charterboat fishing trips. Nearshore fishing and trolling were the next most prevalent fishing methods over the survey period (Table 2).

Study participants most often fished at the large multiwell production platforms, based on the mean submerged surface area and volume of water enclosed by a structure, with charterboat operators fishing at larger platforms than private boat anglers for all three types of fishing (Table 3), although the study participants utilized the available size range of structures from single well caissons to semi-submersible drilling platforms.

Table 2
Boat length, engine horsepower, and frequency of presence of electronic equipment for charterboat and angler logbook participant vessels.

	N	Mean	SD	Min.	Max.
Anglers					
Length (m)	55	7.63	2.18	5.18	18.59
Total engine horsepower	55	298.5	183.7	100.0	1200.0
Charterboats					
Length (m)	10	10.09	2.54	7.62	14.33
Total engine horsepower	10	438.5	154.8	225.0	700.0

	Electronic equipment (%)		
	Echosounders	Graph recorders	LORAN
Anglers	72.7	44.5	67.4
Charterboats	68.9	93.8	93.8

Fishing effort was concentrated in late spring, summer, and early fall for both private boat anglers and charter boat operators. The period from May to September in both 1987 and 1988 constituted over 70% private vessel and charterboat fishing trips (Figs. 3, 4).

Participants caught a total of 44465 fish in 1987 and 16792 fish in 1988 from over 46 different species (Table 4). The five most frequently caught species or species groups in 1987 were (in descending order): red snapper, spotted seatrout, silver/sand seatrout, other snapper, and greater amberjack (Table 4). The five most frequently caught species or species groups in 1988 were (in descending order): red snapper, spotted seatrout, other snapper, silver/sand seatrout, and grey triggerfish (Table 4). These five groups represent 73.4% and 70.4% of the total number of fish caught in 1987 and 1988, respectively (Table 4).

CPUE values of spotted seatrout in 1987 were significantly greater ($P<0.01$) than those of 1988 when all data were pooled by user group (Table 5). When the CPUE estimates of each group were pooled by year, CPUE of charterboat operators for spotted seatrout was significantly greater ($P<0.01$) than that of private vessel anglers. Due to the lack of inshore charterboat participants in 1988, comparisons between user groups and years could not be made. The CPUE estimates of spotted seatrout were approximately one order of magnitude greater than those of other commonly caught fish (i.e., bluefish, red drum, and silver/sand seatrout) while inshore fishing during both sample years (Table 5).

Similarly, offshore bottom-fishing CPUE estimates of red snapper during 1987 and 1988 were approximately one order of magnitude greater than those of other commonly caught fish (i.e., Atlantic croaker, bluefish, greater amberjack, grey triggerfish, grouper, other snapper, and silver/sand seatrout) (Table 5).

Table 3
Descriptive statistics on submerged surface area, volume of water enclosed, and water depth of oil and gas platforms fished by logbook participants while trolling and inshore and offshore bottom fishing off Louisiana, 1987. CBO = charterboat operators.

	Submerged surface area (m^2)		Volume of water enclosed (m^3)		Water depth (m)	
	Anglers	CBO	Anglers	CBO	Anglers	CBO
Inshore						
N	149	96	149	96	149	96
Mean	1500.6	3051.8	6878.7	18421.0	7.9	8.8
Min. value	18.7	46.5	18.1	18.1	2.4	3.1
Max. value	13677.8	13677.8	89174.8	89174.8	37.2	62.5
Trolling						
N	122	31	122	31	122	31
Mean	3359.3	11134.0	25915.7	67522.3	26.7	45.4
Min. value	42.0	720.7	0.0	2103.4	6.7	12.2
Max. value	26319.4	144092.6	316654.4	689118.8	129.5	304.8
Offshore bottom fishing						
N	342	361	342	361	342	361
Mean	3705.2	4275.8	27597.7	32673.6	30.1	38.0
Min. value	24.5	151.8	0.0	0.0	3.1	4.0
Max. value	144092.6	144092.6	689118.8	689118.8	304.8	304.8

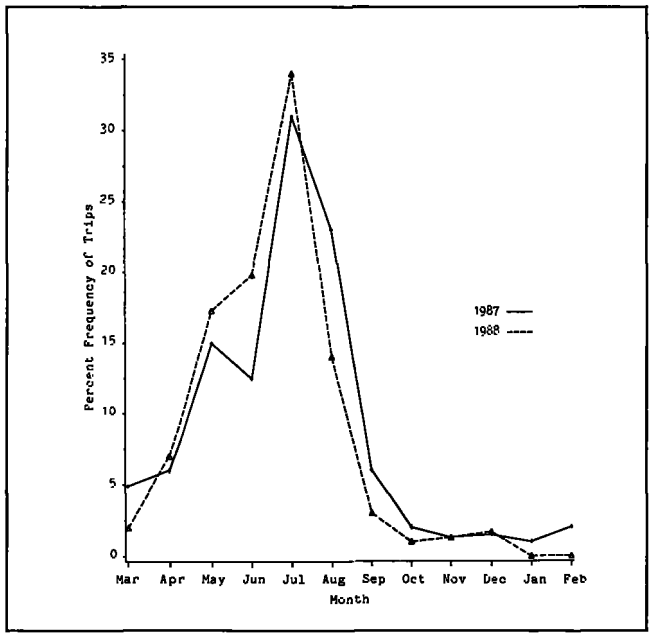

Figure 3
Frequency of offshore fishing trips by month for private vessel angler participants, 1987-88.

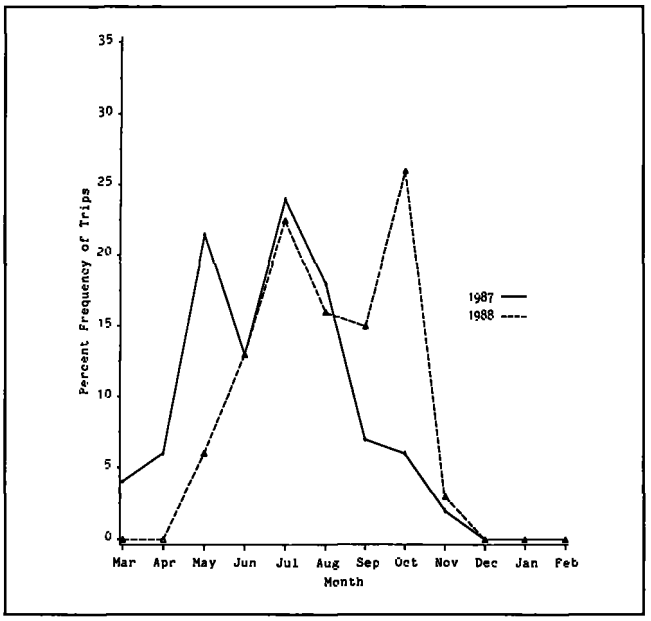

Figure 4
Frequency of offshore fishing trips by month for charterboat operator participants, 1987-88.

Only red snapper were caught often enough to allow statistical comparisons between groups for each year for offshore bottom fishing. Red snapper CPUE of private vessel anglers in 1987 was significantly greater ($P<0.01$) than that of private vessel anglers in 1988 and charterboat operators in 1987 but not significantly greater ($P<0.01$) than that of charterboat operators in 1988.

Offshore trolling CPUE's were not dominated by a single species, nor were they as high as the inshore and offshore bottom fishing CPUE's. Private vessel anglers and charterboat operators most frequently caught blue runner, dolphin, king mackerel, little tunny, and Spanish mackerel while trolling offshore, and the CPUE's of charterboat operators were generally higher, although statistical comparisons were not performed (Table 5).

Private vessel angler and charterboat operator CPUE estimates were pooled for each species to compare CPUE rates between the three regions of coastal Louisiana (Fig. 2) between years. Nearshore CPUE's for all three regions were dominated by spotted seatrout, with the highest CPUE of spotted seatrout found in the Bay region for both 1987 and 1988. The only other striking differences were the CPUE rates of bluefish and red drum which were highest in the Delta region (Table 6). However, due to small sample sizes no statistical comparisons could be performed.

Red snapper CPUE's were the highest in all three regions while offshore bottom fishing. Red snapper CPUE's in the Cameron region during 1987 were significantly greater ($P<0.01$) than those in the Cameron region in 1988; otherwise no significant differences between years or regions for red snapper CPUE were detected (Table 7). Other regional catch differences included much higher CPUE estimates from the Delta region, as opposed to the Cameron and Bay regions, for Atlantic croaker; otherwise no other trends in CPUE were detected between areas or years (Table 7). Due to the large number of zero catches in the species other than red snapper, statistical comparisons could not be performed.

Offshore trolling CPUE estimates from the three regions were not as high or dominated by a single species as were the observed nearshore and offshore bottom-fishing estimates (Table 6). Blue runner, dolphin, little tunny, and Spanish mackerel CPUE's were highest in all three regions. Few trends could be detected between years or regions, as only the CPUE of Spanish mackerel from the Cameron region appeared to be much higher than those of the other species and regions (Table 6), although statistical comparisons could not be made.

Table 4
Composition of catch around oil and gas platforms off Louisiana by logbook participants, 1987–88.

Species/group	1987 No. caught	1987 %	1988 No. caught	1988 %
Atlantic croaker *Micropogonias undulatus*	887	2.0	89	0.5
Atlantic spadefish *Chaetodipterus faber*	23	0.1	110	0.7
Bearded brotula *Brotula barbata*	14	0.0	6	0.0
Black drum *Pogonias cromis*	167	0.4	86	0.5
Blackfin tuna *Thunnus atlanticus*	25	0.1	25	0.1
Bluefish *Pomatomus saltatrix*	1264	2.8	301	1.8
Blue marlin *Makaira nigricans*	4	0.0	1	0.0
Blue runner *Caranx crysos*	279	0.6	256	1.5
Cobia *Rachycentron canadum*	507	1.1	185	1.1
Crevalle jack *Caranx hippos*	63	0.1	26	0.2
Cubbyu *Equetus umbrosus*	5	0.0	—	—
Dolphin *Coryphaena hippurus*	381	0.9	612	3.7
Florida pompano *Trachinotus carolinus*	329	0.7	18	0.1
Flounder *Paralichthys* sp.	8	0.0	12	0.1
Gafftopsail catfish *Bagre marinus*	80	0.2	58	0.3
Great barracuda *Sphyraena barracuda*	93	0.2	19	0.1
Greater amberjack *Seriola dumerili*	1840	4.1	718	4.3
Grey triggerfish *Balistes capriscus*	1221	2.7	990	5.9
Grouper Family: Serranidae	1206	2.7	794	4.7
Grunts *Haemulon* sp.	78	0.2	136	0.8
Hake *Urophycis* sp.	3	0.0	3	0.0
Hardhead catfish *Arius felis*	480	1.1	45	0.3
King mackerel *Scomberomorus cavalla*	543	1.2	201	1.2
Ladyfish *Elops saurus*	29	0.1	3	0.0
Little tunny *Euthynnus alletteratus*	346	0.8	174	1.0
Lookdown *Selene vomer*	9	0.0	28	0.2
Other jacks *Caranx* sp.	54	0.1	9	0.1
Other snapper Family: Lutjanidae	2101	4.7	1355	8.1
Pinfish *Lagodon rhomboides*	127	0.3	74	0.4
Puffer Family: Tetraodontidae	1	0.0	—	—
Rainbow runner *Elagatis bipinnulata*	1	0.0	2	0.0
Rays Family: Dasyatidae	5	0.0	1	0.0
Red drum *Sciaenops ocellatus*	1287	2.9	183	1.1
Red snapper *Lutjanus campechanus*	15385	34.6	6913	41.2
Sharks Order: Selachii	689	1.5	195	1.2
Sheepshead *Archosargus probatocephalus*	39	0.1	25	0.1
Shrimp eel *Ophichthus* sp.	12	0.0	15	0.1
Silver/sand seatrout *Cynoscion* sp.	3663	8.2	974	5.8
Skipjack tuna *Euthynnus pelamis*	624	1.4	258	1.5
Spanish mackerel *Scomberomorus maculatus*	746	1.7	213	1.3
Spotted seatrout *Cynoscion nebulosus*	9688	21.8	1579	9.4
Squirrelfish *Holocentrus* sp.	17	0.0	15	0.1
Tarpon *Megalops atlanticus*	4	0.0	1	0.0
Tripletail *Lobotes surinamensis*	72	0.2	4	0.0
Wahoo *Acanthocybium solanderi*	29	0.1	37	0.2
White spotted soapfish *Rypticus maculatus*	9	0.0	—	—
Yellowfin tuna *Thunnus albacares*	5	0.0	4	0.0
Total	44465		16762	

Table 5

Nearshore, offshore trolling, and offshore bottom fishing CPUE of angler and charterboat operator (CBO) logbook participants, 1987–88, near oil and gas platforms off Louisiana.

	1987				1988			
	Anglers		CBO		Anglers		CBO	
Species/group	Mean	(CV)	Mean	(CV)	Mean	(CV)	Mean	(CV)
Nearshore	n = 174		n = 109		n = 64		n = 4	
Bluefish	0.24	(327)	0.03	(491)	0.22	(256)	0.36	(132)
Cobia	0.03	(460)	0.01	(550)	—	—	0.01	(200)
Hardhead catfish	0.03	(593)	—	—	0.05	(526)	—	—
Red drum	0.16	(330)	0.33	(327)	0.18	(189)	0.56	(98)
Sharks	0.04	(509)	—	—	0.02	(445)	—	—
Silver/sand seatrout	0.55	(374)	0.14	(348)	0.63	(288)	1.40	(200)
Spanish mackerel	0.03	(980)	—	—	0.02	(547)	—	—
Spotted seatrout	3.94	(131)	5.48	(74)	3.33	(138)	0.83	(158)
Offshore bottom fishing	n = 362		n = 578		n = 222		n = 211	
Atlantic croaker	0.17	(631)	0.08	(330)	0.11	(452)	0.01	(698)
Bluefish	0.30	(510)	0.11	(429)	0.11	(608)	0.01	(549)
Blue runner	0.11	(1129)	0.02	(1061)	0.09	(546)	—	—
Cobia	0.08	(360)	0.06	(323)	0.07	(342)	0.04	(258)
Dolphin	0.05	(916)	0.02	(1207)	0.01	(1051)	0.01	(1087)
Greater amberjack	0.30	(391)	0.25	(272)	0.24	(484)	0.19	(264)
Grey triggerfish	0.28	(311)	0.14	(329)	0.39	(289)	0.19	(160)
Grouper	0.23	(282)	0.22	(255)	0.21	(265)	0.30	(158)
Hardhead catfish	0.11	(641)	0.06	(705)	0.01	(1490)	0.01	(908)
King mackerel	0.04	(364)	0.05	(335)	0.03	(626)	0.04	(299)
Other snapper	0.19	(377)	0.37	(245)	0.05	(321)	0.47	(183)
Red drum	0.11	(385)	0.07	(762)	0.06	(462)	—	—
Red snapper	2.83	(171)	2.11	(155)	2.12	(248)	2.53	(148)
Sharks	0.06	(556)	0.12	(431)	0.04	(608)	0.05	(304)
Silver/sand seatrout	0.82	(388)	0.32	(298)	0.30	(256)	0.01	(693)
Spanish mackerel	0.08	(615)	0.03	(1013)	0.02	(887)	—	—
Offshore trolling	n = 130		n = 33		n = 76		n = 14	
Blue runner	0.34	(308)	0.03	(441)	1.02	(229)	0.03	(374)
Cobia	0.02	(397)	0.08	(266)	0.01	(699)	0.02	(296)
Crevalle jack	0.07	(398)	0.10	(446)	0.05	(387)	—	—
Dolphin	0.26	(372)	0.71	(236)	0.25	(502)	1.23	(167)
Greater amberjack	0.12	(598)	0.09	(377)	0.09	(356)	—	—
King mackerel	0.11	(623)	0.62	(151)	0.25	(232)	0.17	(171)
Little tunny	0.43	(222)	0.85	(209)	0.78	(162)	0.21	(241)
Other jacks	0.07	(623)	0.08	(400)	0.02	(872)	—	—
Spanish mackerel	0.51	(271)	0.64	(222)	0.84	(227)	0.42	(288)

Discussion

Private vessel anglers and charterboat operators caught a total of 61227 fish representing over 46 different species. The fishing habits and boat characteristics of study participants were as expected. Peak fishing by private vessel anglers and charterboat operators occurred during the summer which agreed with past studies by Ditton and Auyong (1984) and Stanley and Wilson (1989). During other times of the year, cold fronts and other severe forms of weather make fishing off the coast of Louisiana nearly impossible or at least uncomfortable. Based on number of trips, the most prevalent fishing method was offshore bottom fishing, with nearshore and offshore trolling the next most popular methods for the study participants.

Private vessel anglers and charterboat operators utilized the entire range of platform sizes and operational types off the coast of Louisiana. Single well structures, steel template platforms, and mobile semisubmersible drilling platforms were commonly fished, although certain trends in platform size utilization and fishing method were apparent. Nearshore anglers most often fished at the small, single well structures

Table 6

Nearshore and offshore trolling CPUE of logbook participants around oil and gas platforms in the Delta, Bay, and Cameron Regions off Louisiana, 1987–88.

	Delta		Bay		Cameron	
	1987	1988	1987	1988	1987	1988
Species/group	Mean (CV)	Mean (CV)	Mean (CV)	Mean (CV)	Mean (CV)	Mean (CV)
Nearshore	$n = 48$	$n = 8$	$n = 196$	$n = 46$	$n = 37$	$n = 12$
Bluefish	0.68 (197)	1.28 (64)	0.04 (537)	0.02 (678)	0.14 (324)	0.22 (234)
Cobia	0.06 (259)	0.03 (144)	0.01 (947)	— —	0.02 (370)	— —
Hardhead catfish	— —	— —	0.03 (606)	0.07 (444)	— —	— —
Red drum	0.99 (169)	0.80 (49)	0.02 (660)	0.11 (249)	0.39 (258)	0.07 (186)
Sharks	0.01 (495)	0.03 (494)	0.03 (632)	0.03 (439)	0.05 498)	— —
Silver/sand seatrout	0.25 (326)	0.08 (282)	0.38 (444)	0.85 (249)	0.53 (226)	0.55 (293)
Spanish mackerel	0.09 (557)	— —	0.02 (608)	0.01 (475)	0.02 (608)	0.07 (346)
Spotted seatrout	1.73 (125)	0.48 (70)	5.70 (87)	4.28 (119)	2.02 (97)	1.29 (83)
Offshore trolling	$n = 78$	$n = 50$	$n = 23$	$n = 13$	$n = 63$	$n = 27$
Bluerunner	0.46 (260)	0.71 (230)	0.20 (425)	1.06 (234)	0.09 (441)	1.06 (269)
Cobia	0.04 (372)	0.02 (592)	0.03 (303)	— —	0.03 (369)	0.01 (388)
Crevalle jack	0.01 (590)	— —	0.07 (268)	0.07 (361)	0.15 (311)	0.10 (263)
Dolphin	0.20 (276)	0.48 (363)	0.68 (298)	0.15 (177)	0.40 (312)	0.39 (298)
Greater amberjack	0.05 (630)	— —	0.14 (315)	0.27 (158)	0.18 (509)	0.12 (350)
King mackerel	0.04 (455)	0.05 (506)	0.07 (209)	0.29 (165)	0.49 (157)	0.55 (140)
Little tunny	0.69 (205)	0.73 (173)	0.14 (215)	0.50 (174)	0.43 (199)	0.72 (174)
Other jacks	0.08 (625)	0.03 (707)	0.14 (381)	— —	0.05 (498)	— —
Spanish mackerel	0.25 (363)	0.24 (262)	0.28 (270)	0.46 (302)	1.06 (196)	1.91 (145)

Table 7

Offshore bottom fishing CPUE of logbook participants around oil and gas platforms in the Delta, Bay, and Cameron Regions off Louisiana, 1987–88.

	Delta		Bay		Cameron	
	1987	1988	1987	1988	1987	1988
Species/group	Mean (CV)	Mean (CV)	Mean (CV)	Mean (CV)	Mean (CV)	Mean (CV)
	$n = 627$	$n = 280$	$n = 196$	$n = 77$	$n = 153$	$n = 75$
Atlantic croaker	0.16 (518)	0.10 (485)	0.02 (694)	— —	0.04 (393)	— —
Bluefish	0.23 (592)	0.02 (539)	0.11 (422)	0.25 (437)	0.08 (689)	0.02 (672)
Cobia	0.05 (367)	0.05 (362)	0.14 (310)	0.08 (282)	0.08 (242)	0.05 (273)
Greater amberjack	0.30 (331)	0.11 (487)	0.18 (325)	0.15 (235)	0.25 (224)	0.65 (275)
Grey triggerfish	0.26 (287)	0.25 (217)	0.07 (571)	0.50 (288)	0.09 (386)	0.23 (391)
Grouper	0.26 (238)	0.30 (183)	0.16 (416)	0.20 (283)	0.15 (277)	0.15 (230)
King mackerel	0.02 (449)	0.03 (384)	0.07 (198)	0.02 (330)	0.14 (224)	0.07 (439)
Other snapper	0.40 (240)	0.56 (217)	0.13 (508)	0.55 (329)	0.07 (336)	0.14 (542)
Red drum	0.10 (524)	0.02 (876)	0.09 (633)	0.02 (445)	0.05 (338)	0.08 (356)
Red snapper*	2.33 (187)^{ab}	2.27 (162)^{ab}	2.62 (124)^{ab}	2.72 (247)^{ab}	2.85 (132)^{a}	2.19 (237)^{b}
Sharks	0.11 (421)	0.05 (428)	0.03 (379)	0.04 (591)	0.08 (596)	0.02 (301)
Silver/sand seatrout	0.68 (369)	0.20 (328)	0.17 (383)	0.15 (363)	0.12 (460)	0.02 (699)
Spanish mackerel	0.02 (1153)	0.01 (1471)	0.12 (536)	0.01 (560)	0.12 (498)	0.02 (442)

* Means with the same letter are not significantly different at the 1% level.

in shallow water, while offshore bottom fishing and trolling anglers fished much larger steel template platforms in deep water. These results provide evidence that participants were maximizing their catch potential, as Stanley (1989) found highest abundances of spotted seatrout near small platforms in shallow water, while highest abundances of red snapper and related species were found near large platforms (sub-

merged surface area 8000–14000 m^2) in 70–100 m of water.

Charterboat operators had larger vessels than private vessel anglers due to the business nature of their fishing and larger party size. Using larger vessels, they were able to fish in deeper waters farther offshore than private vessel anglers for both offshore bottom fishing and trolling. Charterboat operators also fished in deeper water while fishing nearshore; however, this is probably not a direct function of boat size, but of past success and preference.

A high diversity of fish exist around the oil and gas platforms as evidenced by the reported catch of over 46 different species. The types of fish caught ranged from relatively common and highly desirable species such as spotted seatrout, red snapper, tarpon, blue marlin, king mackerel, and yellowfin tuna to rather rare fishes such as hake, bearded brotula, and squirrel fish. However, catches by angling are selective and biased towards larger, carnivorous individuals due to the gear utilized (Grimes et al. 1982). Therefore, species not susceptible to angling were not represented.

Comparison of CPUE estimates between this study and logbook programs from other parts of North America revealed CPUE estimates were generally much higher off the Louisiana coast than from other studies. CPUE estimates from Sztramko (1986) for Lake Erie, Ontario, private vessel anglers and charterboat operators were approximately 0.15 for the target species of smallmouth bass *Micropterus dolomieui* and coho salmon *Oncorhynchus kisutch*, while Casselman et al. (1985) reported CPUE estimates of 0.30 for northern pike *Esox lucius* by sportfishing guides on the St. Lawrence River, Ontario. Only CPUE estimates from logbooks maintained by commercial fishermen trolling for Pacific salmon (Jordan and Carter 1987) were as high as CPUE estimates from this study.

Catch rates in this study, presented as number of fish per angler per hour, are not directly or statistically comparable with those reported by Brusher et al. (1984), Brusher and Palko (1985, 1987), and other earlier studies from the Gulf of Mexico because they used number of fish caught per boat per hour (CPH) as a unit of relative abundance. Since the number of anglers on a sportfishing vessel can be highly variable, catch per vessel hour may also be highly variable. By calculating the number of fish caught per angler hour, catch is broken down to its most standard unit, assuming the skill level of anglers is equal, thus eliminating this source of variance.

CPH rates by bottom fishing and trolling from this and other studies off the Louisiana coast were much higher than in other regions of the Gulf of Mexico and the southeast Atlantic. However, when mean number of anglers was multiplied by CPUE for charterboat operators from this study and compared with Brusher et al. (1984) and Brusher and Palko (1985, 1987), similar catch rates were noted for the Louisiana coast.

Comparison of the catch rates and composition of trolling from this study and others revealed few differences. Brusher et al. (1984) and Brusher and Palko (1987) found trolling catches of charterboat operators off Louisiana were primarily comprised of dolphin, Spanish mackerel, red drum, little tunny, king mackerel, and blue runner. We found little change in this trend with the exception of red drum. Based on our results, red drum do not appear to be associated with oil and gas structures. Other logbook programs off the Louisiana coast did not distinguish between areas fished (near oil and gas platforms or otherwise) (Dugas et al. 1979), and consequently red drum catches may have been high in areas not covered by our logbook program, which may explain their absence from our results.

When catch rates and composition of our study were compared with those of other logbook programs and a creel census for offshore bottom fishing, major differences in catch composition were noted. Past studies conducted during 1978 by Dugas et al. (1979), in 1982 by Brusher et al. (1984), and during 1984–85 by Brusher and Palko (1987), found that Atlantic croaker and silver/sand seatrout dominated catches of charterboat operators while we found that red snapper catch rates were often an order of magnitude greater than for all other species caught. Since many of the same charterboat operators were utilized by both ours and earlier studies, these differences may provide evidence that there has been a shift in the species abundance near oil and gas platforms in offshore waters with little or no change in the composition of the structure (i.e., the number of oil and gas platforms) off the Louisiana coast. Comparison of our nearshore catches around oil and gas platforms with those of creel surveys of Texas bay charterboat operators from 1978 to 1979 (McEachron and Matlock 1983) showed that spotted seatrout dominated the catch rate and composition of nearshore Texas fishermen as they did in Louisiana, although spotted seatrout catches off Louisiana were much higher than for Texas sport fishermen.

Overall CPUE's of all species between private vessel anglers and charterboat operators were very similar; however, charterboat operator CPUE was generally less variable. Few trends were identified from comparisons between years or user groups. Only for spotted seatrout was charterboat operator CPUE consistently higher than private vessel angler CPUE; otherwise few differences were noted between the two groups. The similarity of the CPUE's indicated that the anglers participating in the logbook program were avid,

knowledgeable fishermen who were as skilled as the professional charterboat operators.

The CPUE of the study participants was probably much higher than that for average offshore saltwater fishermen in Louisiana. Since charterboat operators are professional fishermen who make their living by catching fish, and the private vessel anglers participating in the program were equally as skilled, the catch rates by these groups do not reflect average catches. Both groups have a higher success rate than do casual fishermen who rarely catch fish due to improper techniques and do not target their effort (Casselman et al. 1985). Consequently, the CPUE's presented are not applicable to all fishermen, only to skilled, dedicated, amateur anglers and charterboat operators.

Spotted seatrout and red snapper were the target species of private vessel anglers and charterboat operators, as indicated by their domination of respective CPUE estimates for nearshore and offshore bottom fishing and based on past research from a saltwater recreational angling survey (Stanley and Wilson 1989). Casselman et al. (1985) reported that the CPUE of avid recreational fishermen can be used as an index of relative abundance, and if data are collected over a long period of time, changes in CPUE can reflect fluctuations in the populations of the target species. Offshore trolling CPUE was not dominated by a single species, indicating that fishermen were not targeting their effort for any particular species; therefore, CPUE estimates while trolling would not reflect changes in abundance to the same extent as nearshore and offshore bottom-fishing CPUE estimates.

Conclusions

The catch rates of private vessel anglers and charterboat operators around oil and gas platforms in the northern Gulf of Mexico were high, with their effort targeted towards red snapper while offshore bottom fishing, and spotted seatrout while nearshore fishing. Catch rates while trolling were more uniform and not dominated by any one species. Catch rates between the user groups and across the regions were similar, although some minor differences were detected.

Based on comparisons of catch rates and composition between our results and past studies, a shift in the abundance of certain species has occurred near oil and gas platforms off the Louisiana coast. Studies from 1978 to 1985 found Atlantic croaker and silver/sand seatrout constituted the largest portion of the catch and had the highest catch rates, while we found that red snapper dominated the catch statistics while offshore bottom fishing. Little change in the patterns of species abundance appears to have occurred for species targeted while offshore trolling and nearshore fishing around oil and gas platforms, based on comparisons with earlier studies.

The physical construction of oil and gas platforms precludes the sampling of the associated sportfish populations using traditional methods (e.g., gillnets, trawls). The success of this logbook program indicates that the collection of CPUE data over long periods of time may be an effective technique of monitoring fish populations associated with the platforms. Although the data supplied by the logbooks is an index of relative abundance of fish susceptible to angling and is biased towards larger individuals, it provides a valuable source of data which is otherwise difficult to obtain.

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